PB-240 513

LAKE PEPIN, GOODHUE AND WABASHA COUNTIES, MINNESOTA, AND PIERCE AND PEPIN COUNTIES, WISCONSIN

Pacific Northwest Environmental Research Laboratory

Prepared for:

National Environmental Research Center
Minnesota Pollution Control Agency
Minnesota National Guard

January 1974

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	PB 240 513

4. TITLE AND SUBTITLE
Report on Lake Pepin, Goodhue and Wabasha Counties, Minnesota and Pierce and Pepin Counties, Wisconsin

5. REPORT DATE
Prepared January 1975

6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)
Anonymous (National Eutrophication Survey Staff)

8. PERFORMING ORGANIZATION REPORT NO.
Working Paper # 119

9. PERFORMING ORGANIZATION NAME AND ADDRESS
Pacific Northwest Environmental Research Laboratory
U.S.Environmental Protection Agency
200 S. W. 35th St.
Corvallis, Oregon 97330

10. PROGRAM ELEMENT NO.
1BA029

11. CONTRACT/GRANT NO.

12. SPONSORING AGENCY NAME AND ADDRESS
Office of Research and Development
U.S. Environmental Protection Agency
401 M Street, S. W.
Washington, DC 20460

13. TYPE OF REPORT AND PERIOD COVERED
Final - 1972

14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT
Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivded according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

PRICES SUBJECT TO CHANGE

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
Release unlimited		47
	20. SECURITY CLASS *(This page)*	22. PRICE
		$3.75

EPA Form 2220-1 (9-73)

I

REPORT

ON

LAKE PEPIN

GOODHUE AND WABASHA COUNTIES, MINNESOTA

AND

PIERCE AND PEPIN COUNTIES, WISCONSIN

EPA REGION V

WORKING PAPER No. 119

WITH THE COOPERATION OF THE

MINNESOTA POLLUTION CONTROL AGENCY

AND THE

MINNESOTA NATIONAL GUARD

JANUARY, 1975

II

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Minnesota Pollution Control Agency for professional involvement and to the Minnesota National Guard for conducting the tributary sampling phase of the Survey.

Grant J. Merritt, Director of the Minnesota Pollution Control Agency, John F. McGuire, Chief, and Joel G. Schilling, Biologist, of the Section of Surface and Groundwater, Division of Water Quality, provided invaluable lake documentation and counsel during the course of the Survey; and the staff of the Section of Municipal Works, Division of Water Quality, were most helpful in identifying point sources and soliciting municipal participation in the Survey.

Major General Chester J. Moeglein, the Adjutant General of Minnesota, and Project Officer Major Adrian Beltrand, who directed the volunteer efforts of the Minnesota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

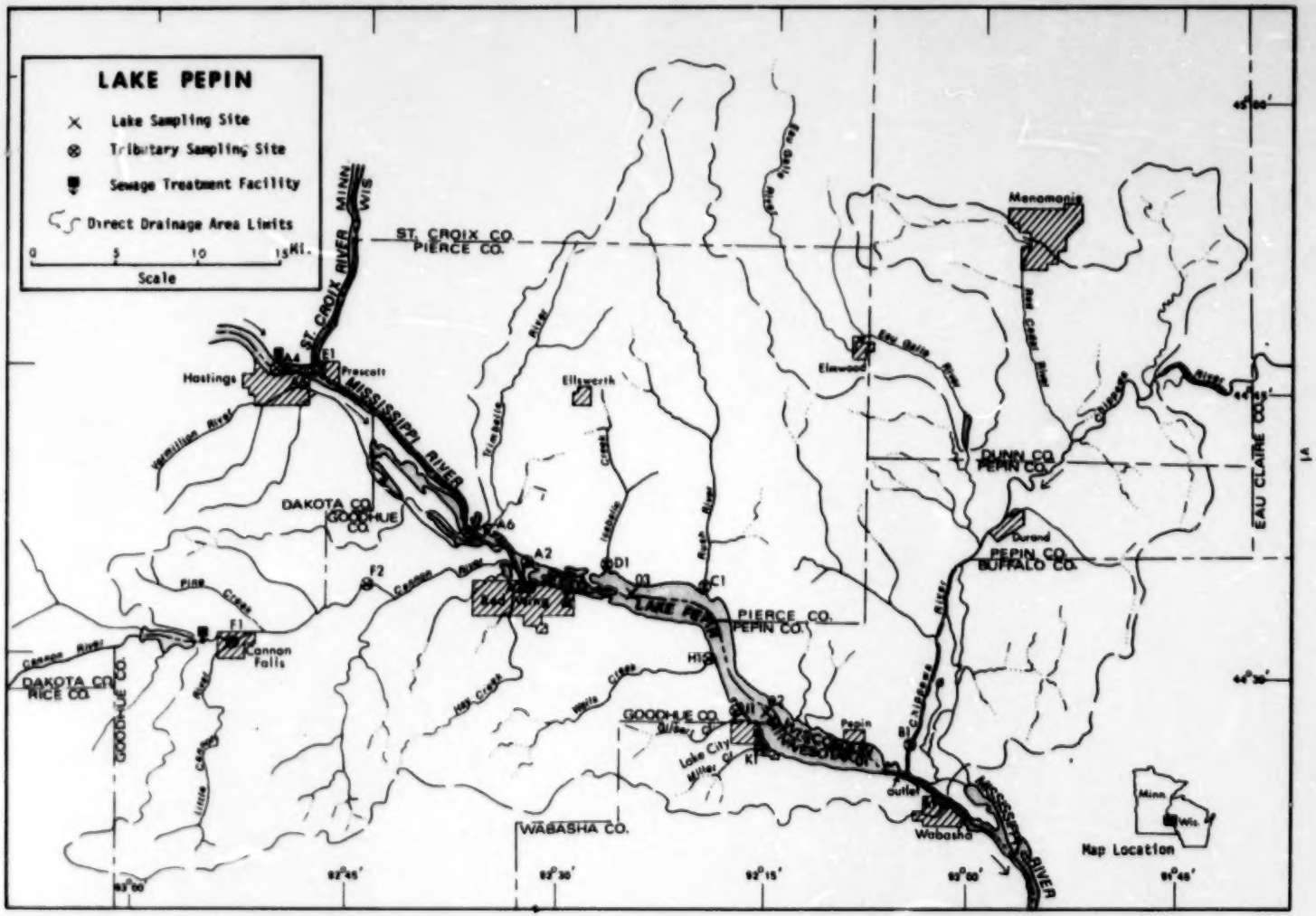
NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF MINNESOTA

LAKE NAME	COUNTY
Albert Lea	Freeborn
Andrusia	Beltrami
Badger	Polk
Bartlett	Koochiching
Bear	Freeborn
Bemidji	Beltrami
Big	Stearns
Big Stone	Big Stone, MN; Roberts, Grant, SD
Birch	Cass
Blackduck	Beltrami
Blackhoof	Crow Wing
Budd	Martin
Buffalo	Wright
Calhoun	Hennepin
Carlos	Douglas
Carrigan	Wright
Cass	Beltrami, Cass
Clearwater	Wright, Stearns
Cokato	Wright
Cranberry	Crow Wing
Darling	Douglas
Elbow	St. Louis
Embarass	St. Louis
Fall	Lake
Forest	Washington
Green	Kandiyohi
Gull	Cass
Heron	Jackson
Leech	Cass
Le Homme Dieu	Douglas
Lily	Blue Earth
Little	Grant
Lost	St. Louis

LAKE NAME	COUNTY
Madison	Blue Earth
Malmedal	Pope
Mashkenode	St. Louis
McQuade	St. Louis
Minnetonka	Hennepin
Minnewaska	Pope
Mud	Itasca
Nest	Kandiyohi
Pelican	St. Louis
Pepin	Goodhue, Wabasha, MN; Pierce, Pepin, WI
Rabbit	Crow Wing
Sakatah	Le Sueur
Shagawa	St. Louis
Silver	McLeod
Six Mile	St. Louis
Spring	Washington, Dakota
St. Croix	Washington, MN; St. Croix, Pierce, WI
St. Louis Bay	St. Louis, MN; Douglas, WI
Superior Bay	St. Louis, MN; Douglas, WI
Swan	Itasca
Trace	Todd
Trout	Itasca
Wagonga	Kandiyohi
Wallmark	Chisago
White Bear	Washington
Winona	Douglas
Wolf	Beltrami, Hubbard
Woodcock	Kandiyohi
Zumbro	Olmstead, Wabasha


LAKE PEPIN
Lake Sampling Site
Tributary Sampling Site
Sewage Treatment Facility
Direct Drainage Area Limits
0 5 10 15 Mi.
Scale
ST. CROIX RIVER
MINN
WIS
ST. CROIX CO.
PIERCE CO.
Hastings
Prescott
MISSISSIPPI RIVER
Vermillion River
DAKOTA CO.
GOODHUE CO.
Pine Creek
Cannon River
Cannon Falls
DAKOTA CO.
RICE CO.
GOODHUE CO.
Little Cannon River
Ellsworth
Trimbelle River
Isabella Creek
Rush River
LAKE PEPIN
PIERCE CO.
PEPIN CO.
Hay Creek
White Creek
GOODHUE CO.
Lake City
Miller Creek
Pepin
Outlet
Wabasha
WABASHA CO.
MISSISSIPPI RIVER
Menomonie
Red Cedar River
Elmwood
Eau Galle River
DUNN CO.
PEPIN CO.
Durand
PEPIN CO.
BUFFALO CO.
EAU CLAIRE CO.
Chippewa River
Map Location
Minn.
Wis.
92°00'
92°45'
92°30'
92°15'
92°00'
91°45'
45°00'
44°45'
44°30'

LAKE PEPIN

STORET NO. 27A4

I. CONCLUSIONS

A. Trophic Condition:

Survey data show that Lake Pepin is eutrophic. Of the 60 Minnesota lakes sampled in the fall of 1972, when essentially all were well-mixed, 42 had less mean total phosphorus, 43 had less mean dissolved phosphorus, and 51 had less mean inorganic nitrogen. Of all 80 Minnesota lakes sampled, 35 had less mean chlorophyll a, and 42 had greater Secchi disc transparency.

Depression of dissolved oxygen with depth occurred at stations 1 and 2 in June, and low dissolved oxygen occurred at all stations in September, 1972.

B. Rate-Limiting Nutrient:

A significant loss of nutrients occurred in the algal assay sample between the time of collection and the beginning of the assay, and the results are not indicative of conditions in the lake at the time of sampling. However, the lake data show nitrogen limitation at all sampling times (N/P ratios were less than 10/1 on all occasions).

C. Nutrient Controllability:

1. Point sources--During the sampling year, Lake Pepin received a total phosphorus load at a rate nearly 11 times the rate proposed by Vollenweider (in press) as "dangerous";

i.e., a eutrophic rate, see page 15). However, the mean hydraulic retention time of Lake Pepin is quite short, and Vollenweider's model may not be applicable. Nonetheless, the present trophic condition of the lake is indicative of excessive nutrient loads.

It is calculated that complete removal of phosphorus at the point sources considered in this study, including the point sources impacting upstream Spring Lake* and Lake St. Croix**, would reduce the loading rate to about 21.6 $g/m^2/yr$ or about six times the eutrophic rate. A more realistic phosphorus removal of 80% at the point sources would reduce the loading rate to about 24.1 $g/m^2/yr$ or about 7½ times the eutrophic rate. However, in view of the questionable applicability of Vollenweider's model to Lake Pepin, it is believed that a high degree of point-source phosphorus removal would improve the trophic condition of Lake Pepin, particularly if the high phosphorus exports of the Lake Pepin tributaries (see below) can be reduced by point or non-point phosphorus control.

2. Non-point sources (see page 14)--During the sampling year, the phosphorus exports of all of the tributaries

* Working Paper No. 127.
** Working Paper No. 122.

to Lake Pepin were quite high. For example, the Mississippi River, which had a mean non-point phosphorus export of about 77 lbs/mi^2/yr at the outlet of Spring Lake, had a non-point export of 102 lbs/mi^2/yr at the inlet to Lake Pepin. Since the mean non-point export of the St. Croix River near Prescott, Wisconsin, was only 75 lbs/mi^2/yr, it appears that unmeasured point or non-point phosphorus sources between the Hastings, Minnesota-Prescott, Wisconsin area and the inlet of Lake Pepin contributed significantly to the Mississippi River export.

Likewise, the high phosphorus exports of the other tributaries, ranging from 113 lbs to 216 lbs/mi^2/yr, are indicative of unmeasured point or non-point source impacts.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

A. Lake Morphometry†:

1. Surface area: 25,000 acres.
2. Mean depth: 16.7 feet.
3. Maximum depth: 56 feet.
4. Volume: 417,500 acre-feet.
5. Mean hydraulic retention time: 9 days.

B. Tributary and Outlet:
(See Appendix A for flow data)

1. Tributaries -

Name	Drainage area*	Mean flow*
Mississippi River	46,600.0 mi^2	15,856.6 cfs
Chippewa River	9,470.0 mi^2	7,205.3 cfs
Rush River	203.0 mi^2	92.3 cfs
Isabelle Creek	42.0 mi^2	19.1 cfs
Wells Creek	69.2 mi^2	29.2 cfs
Gilbert Creek	25.1 mi^2	11.4 cfs
Miller Creek	17.8 mi^2	7.5 cfs
Minor tributaries & immediate drainage -	133.8 mi^2	65.2 cfs
Totals	56,560.9 mi^2	23,286.6 cfs

2. Outlet -

Mississippi River**	56,600.0 mi^2	23,286.6 cfs

C. Precipitation***:

1. Year of sampling: 35.1 inches.
2. Mean annual: 24.4 inches.

† DNR lake survey map (1960); mean depth by random-dot method.
* Drainage areas are accurate within ±5%; mean daily flows are accurate within ±10%; and ungaged flows are accurate within ±10 to 25% for drainage areas greater than 10 mi^2.
** Includes area of lake; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 1, "Survey Methods".

III. LAKE WATER QUALITY SUMMARY

Lake Pepin was sampled three times during the open-water season of 1972 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from three stations on the lake and usually from a number of depths at each station (see map, page vi). During each visit, a single depth-integrated (15 feet or near bottom to surface) sample was composited from the three stations for phytoplankton identification and enumeration; and during the last visit, a single five-gallon depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 28 feet at station 1, 27 feet at station 2, and 19 feet at station 3.

The results obtained are presented in full in Appendix B, and the data for the fall sampling period, when the lake essentially was well-mixed, are summarized below. Note, however, the Secchi disc summary is based on all values.

For differences in the various parameters at the other sampling times, refer to Appendix B.

A. Physical and chemical characteristics:

FALL VALUES

(11/04/72)

Parameter	Minimum	Mean	Median	Maximum
Temperature (Cent.)	6.3	6.6	6.6	6.7
Dissolved oxygen (mg/l)	9.2	9.8	9.6	10.6
Conductivity (µmhos)	430	445	445	460
pH (units)	7.7	7.8	7.8	7.8
Alkalinity (mg/l)	149	155	151	166
Total P (mg/l)	0.163	0.190	0.177	0.233
Dissolved P (mg/l)	0.126	0.137	0.137	0.148
NO_2 + NO_3 (mg/l)	0.620	0.732	0.690	0.940
Ammonia (mg/l)	0.430	0.451	0.440	0.480
		ALL VALUES		
Secchi disc (inches)	12	33	34	48

B. Biological characteristics:

1. Phytoplankton* -

Sampling Date	Dominant Genera	Number per ml
06/28/72	1. Aphanocapsa	1,817
	2. Microcystis	172
	3. Dinobryon	126
	4. Synedra	108
	5. Cocconeis	81
	Other genera	200
	Total	2,504
09/03/72	1. Merismopedia	66,000
	2. Kirschneriella	35,818
	3. Microcystis	21,818
	4. Aphanocapsa	8,727
	5. Chroococcus	5,818
	Other genera	18,364
	Total	156,545

2. Chlorophyll a -
(Because of instrumentation problems during the 1972 sampling, the following values may be in error by plus or minus 20 percent.)

Sampling Date	Station Number	Chlorophyll a (µg/l)
06/28/72	01	11.2
	02	16.0
	03	35.0
09/03/72	01	4.8
	02	4.8
	03	7.0
11/04/72	01	6.1
	02	21.6
	03	27.4

* The November sample was lost in shipment.

C. Limiting Nutrient Study:

A significant loss of nutrients occurred in the algal assay sample between the time of collection and the beginning of the assay, and the results are not indicative of conditions in the lake at the time of sampling. However, the lake data indicate nitrogen limitation at all sampling times (N/P ratios were less than 10/1 on all occasions).

IV. NUTRIENT LOADINGS
(See Appendix C for data)

For the determination of nutrient loadings, the Minnesota National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page vi), except for the high runoff months of March and May when two samples were collected. Sampling was begun in October, 1972, and was completed in September, 1973.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Minnesota District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated by using the means of the nutrient loads, in $lbs/mi^2/year$, at stations C-1, H-1, J-1, and K-1 and multiplying the means by the ZZ area in mi^2.

The Chippewa River was sampled during the Survey, and nutrient loads were determined. However, this river joins the Mississippi River downstream from the actual outlet of Lake Pepin but upstream from the Survey outlet sampling station at A-1. Consequently, the Chippewa River nutrient loads were subtracted from the loads measured at A-1 to arrive at the

* See Working Paper No. 1.

actual outlet loads. The nutrient loads given for the other tributaries are those measured minus point sources, if any.

The operator of the Hastings wastewater treatment plant provided monthly effluent samples and corresponding flow data. Nutrient loadings for the cities of Red Wing, Lake City, and Cannon Falls, Minnesota, and Pepin, Prescott, and Ellsworth, Wisconsin, were estimated at 2.5 lbs P and 7.5 lbs N/capita/year.

The nutrient loads from the Ellsworth Creamery were not measured; but, on the basis of comparable flows, the phosphorus load from the Creamery was estimated to be the same as the Ellsworth waste treatment plant load. However, nitrogen loads in dairy processing wastes are usually about 1.4 times the phosphorus loads (Boydston, 1973), and the Creamery nitrogen loads were estimated on that basis.

In the following loading tables, the point-source loads given for Spring Lake point sources (above Hastings, MN) are those measured in the Spring Lake study* adjusted for the calculated retention in that lake (3% for phosphorus, none for nitrogen). The point source loads given for Lake St. Croix point sources (above Prescott, WI) are those measured in the St. Croix Lake study** adjusted for the calculated retention in that lake (33% for phosphorus, <2% for nitrogen).

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* See Working Paper No. 127.
** See Working Paper No. 122.

A. Waste Sources:

1. Known municipal† -

Name	Pop. Served	Treatment	Mean Flow (mgd)	Receiving Water
Hastings	12,179	act. sludge	1.373	Mississippi River
Red Wing	10,441	trickling filter	0.104*	Mississippi River
Lake City	3,594	act. sludge	0.359*	Mississippi River
Cannon Falls	2,095	trickling filter	0.210*	Mississippi River
Pepin	1,487	primary	0.065**	Mississippi River
Ellsworth	3,243	trickling filter	0.175**	Isabelle Creek
Prescott	2,331	primary	0.200***	Mississippi River

2. Known industrial** -

Name	Treatment	Mean Flow (mgd)	Receiving Water
Ellsworth Creamery	act. sludge	0.220	Isabelle Creek

† Anonymous, 1974; McKersie, et al., 1971.
* Estimated at 100 gal/capita/day.
** McKersie, et al., 1971.
*** McKersie, et al., 1972.

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	lbs P/ yr	% of total
a. Tributaries (non-point load) -		
Mississippi River	4,734,170	61.7
Rush River	22,900	0.3
Isabelle Creek	5,990	0.1
Gilbert Creek	5,410	0.1
Wells Creek	14,220	0.2
Miller Creek	2,550	<0.1
b. Minor tributaries & immediate drainage (non-point load) -	22,650	0.3
c. Known municipal STP's -		
Hastings	35,210	0.5
Red Wing	26,100	0.3
Lake City	8,980	0.1
Prescott	5,830	0.1
Cannon Falls	5,240	0.1
Pepin	3,720	<0.1
Ellsworth	8,110	0.1
Spring Lake point sources	2,706,740	35.3
Lake St. Croix point sources	50,870	0.7
d. Septic tanks - Unknown	?	-
e. Known industrial -		
Ellsworth Creamery	8,110	0.1
f. Direct precipitation* -	3,900	<0.1
Total	7,670,700	100.0

2. Outputs -

Lake outlet - Mississippi River 6,802,730

3. Net annual P accumulation - 867,970 pounds

* See Working Paper No. 1.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	lbs N/yr	% of total
a. Tributaries (non-point load) -		
Mississippi River	93,379,310	89.3
Rush River	435,360	0.4
Isabelle Creek	73,710	0.1
Gilbert Creek	48,250	<0.1
Wells Creek	154,590	0.1
Miller Creek	36,820	<0.1
b. Minor tributaries & immediate drainage (non-point load) -	279,940	0.3
c. Known municipal STP's -		
Hastings	107,470	0.1
Red Wing	78,310	0.1
Lake City	26,960	<0.1
Prescott	17,480	<0.1
Cannon Falls	15,710	<0.1
Pepin	11,150	<0.1
Ellsworth	24,320	<0.1
Spring Lake point sources	9,370,830	9.0
St. Croix Lake point sources	261,700	0.2
d. Septic tanks - Unknown	?	-
e. Known industrial -		
Ellsworth Creamery	11,360	<0.1
f. Direct precipitation* -	240,860	0.2
Total	104,574,130	100.0

2. Outputs -

Lake outlet - Mississippi River 111,377,560

3. Net annual N loss - 6,803,430 pounds

* See Working Paper No. 1.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	lbs P/mi^2/yr	lbs N/mi^2/yr
Mississippi River	102	2,004
Rush River	113	2,145
Isabelle Creek (estimated)	143	1,755
Gilbert Creek	216	1,922
Wells Creek	205	2,234
Miller Creek	143	2,069

E. Yearly Loading Rates:

In the following table, the existing phosphorus loading rates are compared to those proposed by Vollenweider (in press). Essentially, his "dangerous" rate is the rate at which the receiving waters would become eutrophic or remain eutrophic; his "permissible" rate is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic rate would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with very short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
Units	Total	Accumulated	Total	Accumulated
lbs/acre/yr	306.8	34.7	4,183.0	loss*
grams/m^2/yr	34.39	3.89	468.8	-

Vollenweider loading rates for phosphorus ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Pepin:

"Dangerous" (eutrophic rate)	3.20
"Permissible" (oligotrophic rate)	1.60

* There was an apparent loss of nitrogen during the sampling year. This may have been due to nitrogen fixation in the lake, solubilization of previously sedimented nitrogen, recharge with nitrogen-rich ground water, unknown and unsampled point sources discharging directly to the lake, or underestimation of the nitrogen loads from the unmeasured municipal sources. Whatever the cause, similar nitrogen loss has occurred at Shagawa Lake which has been intensively studied by EPA's National Eutrophication Research and Lake Restoration Branch.

V. LITERATURE REVIEWED

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VII. APPENDICES

APPENDIX A

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 2744 PEPIN LAKE

TOTAL DRAINAGE AREA OF LAKE 54600.00

TRIBUTARY	SUB-DRAINAGE AREA	NORMALIZED FLOWS JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
2744A1	54600.00	11415.0	11710.0	24520.0	52875.0	40112.0	34908.0	24039.0	16419.0	18284.0	16338.0	15917.0	12729.0	23288.5
2744A2	46560.00	7261.0	7280.0	15960.0	37540.0	29070.0	24720.0	17660.0	11690.0	11430.0	10730.0	9930.0	7990.0	15856.5
2744A1	8470.00	4250.0	4350.0	8110.0	14960.0	10710.0	9830.0	6105.0	4544.0	6650.0	5430.0	5934.0	4590.0	7205.3
2744C1	203.00	57.40	64.00	142.00	125.00	121.00	141.00	110.00	63.80	90.90	65.50	36.30	56.60	92.27
2744D1	62.00	12.00	13.20	37.60	26.00	25.00	29.10	22.70	13.20	16.70	13.50	7.50	11.70	19.06
2744H1	69.20	15.40	17.70	54.00	45.30	39.80	47.40	35.60	19.90	23.80	19.70	11.40	15.40	29.18
2744J1	25.10	7.15	7.91	22.50	15.60	15.00	17.40	13.60	7.89	10.00	8.10	4.49	7.00	11.41
2744K1	17.40	4.01	4.27	14.80	10.90	10.30	12.40	9.34	5.04	6.79	5.17	2.81	4.20	7.52
2744Z7	172.00	28.20	35.00	103.00	116.00	97.00	120.00	83.90	45.40	52.70	44.30	26.40	29.70	65.23

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 54600.00
SUM OF SUB-DRAINAGE AREAS = 56594.09

TOTAL FLOW IN = 279252.37
TOTAL FLOW OUT = 279272.00

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
2744A1	10	72	31400.00	14	30300.00				
	11	72	39600.00	4	40500.00				
	12	72	14700.00						
	1	73	19300.00						
	2	73	17500.00	27	17500.00				
	3	73	72400.00	30	64400.00				
	4	73	50100.00	18	44100.00				
	5	73	61900.00	3	58400.00	22	55700.00		
	6	73	34400.00	5	49400.00				
	7	73	14300.00	25	12600.00				
	8	73	19300.00	20	19600.00				
	9	73	17700.00	4	21000.00				
2744A2	10	72	17100.00	14	16500.00				
	11	72	24410.00	4	25400.00				
	12	72	11370.00						
	1	73	11400.00						
	2	73	10850.00	27	10800.00				
	3	73	44300.00	20	43000.00				
	4	73	35540.00	14	31500.00				
	5	73	36020.00	2	34200.00				
	6	73	22460.00	5	36400.00				
	7	73	9100.00	25	8000.00				
	8	73	13500.00	20	13700.00				
	9	73	11070.00	4	12400.00				

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TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27A4 PEPIN LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27A4B1	10	72	13890.00	14	12800.00				
	11	72	14250.00	4	19400.00				
	12	72	7039.00						
	1	73	7200.00						
	2	73	6500.00	27	6500.00				
	3	73	22800.00	20	20300.00				
	4	73	14080.00	18	32300.00				
	5	73	24420.00	2	24100.00	22	12500.00		
	6	73	11490.00	5	14700.00				
	7	73	0.0	25	11400.00				
	8	73	0.0	20	7100.00				
	9	73	0.0	4	8700.00				
27A4C1	10	72	162.00	14	136.00				
	11	72	86.80	4	172.00				
	12	72	135.00						
	1	73	81.60						
	2	73	70.40	27	82.00				
	3	73	548.00	20	488.00				
	4	73	184.00	18	386.00				
	5	73	557.00	2	1730.00	22	272.00		
	6	73	161.00	5	242.00				
	7	73	85.00	25	70.00				
	8	73	121.00	20	76.00				
	9	73	133.00	4	129.00				
27A4D1	10	72	33.50	14	28.00				
	11	72	34.80	4	69.00				
	12	72	28.00						
	1	73	16.90						
	2	73	14.50	27	14.00				
	3	73	113.00	20	101.00				
	4	73	38.00	18	80.00				
	5	73	115.00	2	358.00	22	56.00		
	6	73	33.20	5	50.00				
	7	73	17.50	25	14.30				
	8	73	25.10	20	15.80				
	9	73	27.40	4	26.60				
27A4H1	10	72	48.90	14	41.00				
	11	72	52.90	4	105.00				
	12	72	36.80						
	1	73	21.70						
	2	73	19.50	27	20.00				
	3	73	175.00	20	156.00				
	4	73	66.10	18	139.00				
	5	73	183.00	2	569.00	22	90.00		
	6	73	54.00	5	81.00				
	7	73	27.40	25	22.50				
	8	73	37.80	20	23.40				
	9	73	39.00	4	37.90				

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TRIBUTARY FLOW INFORMATION FOR MINNESOTA 10/30/74

LAKE CODE 27A4 PEPIN LAKE

MEAN MONTHLY FLOWS AND DAILY FLOWS

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
27A4J1	10	72	20.10	14	17.00				
	11	72	20.80	4	41.00				
	12	72	16.70						
	1	73	10.10						
	2	73	8.70	27	8.70				
	3	73	67.70	30	60.00				
	4	73	22.80	17	48.00				
	5	73	69.00	2	215.00	22	34.00		
	6	73	19.80	5	34.00				
	7	73	10.50	25	8.60				
	8	73	15.00	20	9.40				
	9	73	16.40	4	16.00				
27A4K1	10	72	12.80	14	11.00				
	11	72	13.00	4	26.00				
	12	72	10.00						
	1	73	5.65						
	2	73	4.31	27	4.30				
	3	73	44.60	20	40.00				
	4	73	15.90	18	33.00				
	5	73	47.40	2	147.00	22	23.00		
	6	73	14.10	5	21.00				
	7	73	7.19	25	5.90				
	8	73	9.58	20	6.00				
	9	73	11.00	4	11.00				
27A4Z2	10	72	110.00	14	92.00				
	1	72	122.00	4	243.00				
	1	72	71.00						
	1	73	39.80						
	2	73	38.50	27	38.00				
	3	73	310.00	20	276.00				
	4	73	169.00	18	355.00				
	5	73	446.00	2	1390.00	22	219.00		
	6	73	137.00	5	206.00				
	7	73	64.60	25	53.00				
	8	73	86.30	20	54.00				
	9	73	86.40	4	84.00				

APPENDIX B

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 74/10/30

27A401
44 25 30.0 092 08 54.0
LAKE PEPIN
27 MINNESOTA

11EPALES
3

2111202
0030 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/28	06 45	0000	23.0	10.6	48	510	7.72	186	1.300	0.120	0.135	0.117
	06 45	0015	20.0	6.7		520	7.48	193	1.300	0.340	0.166	0.141
	06 45	0028	20.0	5.8		540	7.41	194	1.400	0.370	0.205	0.156
72/09/03	14 45	0000				385	7.30	126	0.530	0.280	0.176	0.116
	14 45	0004	20.0	6.1		375	7.40	128	0.530	0.300	0.198	0.126
	14 45	0009	19.9	5.7		400	7.40	127	0.530	0.300	0.207	0.116
72/11/04	08 45	0000			35	440	7.70	149	0.690	0.450	0.163	0.137
	08 45	0004	6.7	9.4		430	7.70	150	0.690	0.440	0.176	0.140
	08 45	0015	6.7	9.2		430	7.70	150	0.680	0.430	0.177	0.142
	08 45	0020	6.7			435	7.70	151	0.690	0.440	0.174	0.137

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DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/28	06 45	0000	11.2J
72/09/03	14 45	0000	4.8J
72/11/04	08 45	0000	6.1J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

27A402
44 27 42.0 092 15 06.0
LAKE PEPIN
27 MINNESOTA

11EPALES 2111202
3 0029 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/28	07	35 0000	23.2	12.7	48	480	7.95	180	0.950	0.120	0.128	0.106
	07	35 0015	21.0	7.1		480	7.63	179	0.970	0.290	0.157	0.123
	07	35 0027	20.5	3.7		490	7.42	182	1.100	0.420	0.215	0.152
72/09/03	15	10 0000			27	300	7.50	136	0.620	0.300	0.193	0.165
	15	10 0004	21.1	5.4		302	7.50	134	0.630	0.290	0.176	0.149
	15	10 0015	21.1	5.4		320	7.50	135	0.590	0.300	0.184	0.144
	15	10 0020	21.0	4.9		300	7.45	135	0.620	0.310	0.197	0.147
	15	10 0025	21.0	4.9		365	7.50	134	0.600	0.300	0.240	0.147
72/11/04	09	10 0000			33	440	7.80	153	0.620	0.470	0.176	0.126
	09	10 0004	6.6	9.6		450	7.80	151	0.620	0.480	0.181	0.128
	09	10 0015	6.6	9.6		445	7.80	152	0.620	0.470	0.186	0.126
	09	10 0020	6.6	9.6		445	7.80	151	0.620	0.470	0.175	0.127

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DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/28	07	35 0000	16.0J
72/09/03	15	10 0000	4.8J
72/11/04	09	10 0000	21.6J

J VALUE KNOWN TO BE IN ERROR

STORET RETRIEVAL DATE 74/10/30

27A403
44 33 50.0 092 25 12.0
LAKE PEPIN
27 MINNESOTA

11EPALES 2111202
3 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00630 NO2&NO3 N-TOTAL MG/L	00610 NH3-N TOTAL MG/L	00665 PHOS-TOT MG/L P	00666 PHOS-DIS MG/L P
72/06/28	13 40	0000	23.0	7.8	12	440	7.73	176	1.000	0.220	0.192	0.125
72/09/03	15 35	0000			45	380	7.45	126	0.750	0.100	0.190	0.167
	15 35	0004	20.7	5.0		300	7.45	126	0.180	0.010	0.156	0.130
	15 35	0015	20.1	4.8		410	7.45	124	0.720	0.110	0.207	0.187
	15 35	0019	20.6	4.6		320	7.45	125	0.710	0.100	0.206	0.178
72/11/04	09 35	0000			19	460	7.80	166	0.940	0.430	0.223	0.147
	09 35	0004	6.3	10.6		460	7.80	165	0.940	0.440	0.218	0.140
	09 35	0011	6.3	10.6		460	7.80	163	0.940	0.440	0.226	0.146

24

DATE FROM TO	TIME OF DAY	DEPTH FEET	32217 CHLRPHYL A UG/L
72/06/28	13 40	0000	35.0J
72/09/03	15 35	0000	7.0J
72/11/04	09 35	0000	27.4J

J VALUE KNOWN TO BE IN ERROR

APPENDIX C

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 74/10/30

27A4A1 LS27A4A1
44 23 00.0 092 02 00.0
MISSISSIPPI RIVER
27 15 WABASHA
O/LAKE PEPIN
WI ST HWY 25 & MN ST HWY 60BRDG NE WABSH
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	09 35		0.620	1.130	0.154	0.126	0.176
72/11/04	09 16		0.670	1.320	0.260	0.120	0.189
73/01/17	14 55		1.000	1.540	0.490	0.140	0.177
73/02/27	10 10		1.300	1.600	0.610	0.160	0.210
73/03/04	10 05		2.300	1.500	0.005K	0.072	0.135
73/03/20			2.040	2.800	0.800	0.189	0.375
73/04/18	09 33		1.760	1.600	0.037	0.028	0.120
73/05/02	13 40		2.200	1.980	0.046	0.031	0.125
73/05/22	13 50		3.000	1.300	0.082	0.054	0.120
73/06/05	08 15		1.280	1.400	0.138	0.056	0.087
73/07/25	12 40		0.260	1.950	0.027	0.088	0.200
73/08/20	14 25		0.200	0.330	0.054	0.160	0.260
73/09/04	13 06		0.460	1.750	0.098	0.147	0.220

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A4A2 LS27A4A2
44 35 00.0 092 32 30.0
WISC CHANNL/MISSISSIPPI RIVER
27 15 RED WING
I/LAKE PEPIN
US 63 BRDG 1 MI S HAGER CITY, WI
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 10		0.580	1.600	0.320	0.110	0.220
72/11/04	10 37		0.532	1.540	0.400	0.138	0.240
73/01/19	09 10		0.870	1.150	0.370	0.110	0.135
73/02/27	11 45		0.930	1.680	0.640	0.147	0.230
73/03/04	11 03		1.920	1.500	0.005K	0.058	0.145
73/03/20			1.940	2.700	0.450	0.096	0.210
73/04/18	16 47		1.540	1.470	0.096	0.040	0.175
73/05/02	14 52		1.540	1.600	0.251	0.078	0.175
73/05/22	10 55		1.720	1.700	0.132	0.060	0.260
73/06/05	09 15		2.900	2.400	0.189	0.084	0.190
73/07/25	13 55		0.670	1.740	0.105	0.100	0.240
73/08/20	13 10		0.150		0.198	0.115	0.210
73/09/04	14 24		0.350	1.600	0.378	0.154	0.230

K VALUE KNOWN TO BE LESS THAN INDICATED

27

STORET RETRIEVAL DATE 74/10/30

27A4A3 LS27A4A3
44 34 00.0 092 32 00.0
MISSISSIPPI RIVER
27 15 RED WING
I/LAKE PEPIN
US 63 BRDG N EDGE RED WING MN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	13 40		0.720	1.750	0.320	0.126	0.260
72/11/04	10 58		0.790	1.740	0.410	0.189	0.340
73/01/18	09 30		1.240	2.800	0.845	0.245	0.430
73/02/27	12 05		1.100	1.540	0.610	0.150	0.230
73/03/04	11 10		2.400	2.200	0.007	0.088	0.210
73/03/20			2.600	1.895	0.450	0.120	0.220
73/04/18	10 55		1.880	2.100	0.198	0.100	0.350
73/05/02	15 00		1.960	2.500	0.290	0.105	0.300
73/05/22	10 45		2.060	3.500	0.490	0.250	
73/06/05	09 25		3.100	2.400	0.231	0.100	0.220
73/07/25	14 15		0.610	1.800	0.100	0.095	0.250
73/08/20	12 35		0.231	1.500	0.270	0.126	0.220
73/09/04	14 30		0.470	1.600	0.340	0.154	0.230

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STORET RETRIEVAL DATE 74/10/30

27A4A4 LS27A4A4
44 45 00.0 092 51 00.0
MISSISSIPPI RIVER
27 IS HASTINGS
T/LAKE PEPIN
US 61 BRDG N HASTINGS ABOVESTP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	08 45		0.442	2.100	0.490	0.152	0.270
72/11/04	07 55		1.100	1.760	0.230	0.120	0.210
72/12/02	10 00		1.940	1.550	0.510	0.160	0.230
73/01/17	10 50		2.500	2.100	0.490	0.132	0.230
73/04/03	11 00		2.800	1.260	0.140	0.069	0.170
73/04/14	09 45		2.100	1.900	0.088	0.034	0.170
73/05/19	10 20		2.900	1.890	0.168	0.064	0.200
73/06/11	09 00		2.800	1.980	0.230	0.115	0.250
73/07/14	11 00		2.400	1.400	0.032	0.210	0.360
73/08/28	11 35		0.260	1.700	0.590	0.189	0.280
73/09/27	11 00		0.370	2.000	0.740	0.250	0.370

STORET RETRIEVAL DATE 74/10/30

27A4A5 LS27A4A5
44 45 00.0 092 49 30.0
MISSISSIPPI RIVER
27 15 HASTINGS
T/LAKE PEPIN
US 10 W PRESCOTT BELOW HASTINGS STP
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/15	09 30		0.560	2.150	0.490	0.150	0.280
72/11/04	11 00		0.740	1.600	0.270	0.115	0.210
72/12/02	11 00		1.800	1.845	0.615	0.169	0.250
73/03/17	09 30		2.400	2.000	0.520	0.147	0.335
73/04/03	10 30		2.700	1.760	0.210	0.082	0.195
73/04/14	09 00		2.050	2.700	0.198	0.048	0.200
73/05/19	09 15		2.800	1.760	0.169	0.066	0.220
73/07/14	09 50		2.200	1.540	0.056	0.220	0.330
73/08/26	11 10		0.290	1.680	0.570	0.190	0.315
73/09/22	10 00		0.320	2.000	0.690	0.260	0.365

STORET RETRIEVAL DATE 74/10/30

27A4A6 LS27A4A6
44 36 30.0 092 36 30.0
MISSISSIPPI RIVER
27 15 RED WING
T/LAKE PEPIN
AT LOCK & DAM 3 5 MI NW REDWING, MN
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	13 05		0.580	1.650	0.340	0.115	0.230
72/11/04	13 30		0.460	1.000	0.300	0.120	0.210
73/01/18	10 10		1.120	1.800	0.690	0.170	0.250
73/02/27	15 10		0.900	1.510	0.660	0.150	0.230
73/03/04	14 00		2.300	1.600	0.165	0.063	0.165
73/03/20			2.300	2.200	0.660	0.120	0.220
73/04/18	13 33		1.600	1.850	0.042	0.044	0.175
73/05/02	11 20		1.760	2.500	0.430	0.068	0.165
73/05/23	10 17		2.300	2.310	0.091	0.051	0.155
73/06/05	11 35		3.300	3.000	0.210	0.092	0.240
73/07/25	14 50		0.357	1.900	0.126	0.092	0.240
73/08/20	11 57		0.168	1.500	0.310	0.126	0.220
73/09/04	10 25		0.320	1.600	0.378	0.150	0.220

STORET RETRIEVAL DATE 74/10/30

27A4B1 LS27A4B1
44 26 30.0 092 04 30.0
CHIPPEWA RIVER (WI)
27 15 WABASHA
T/LAKE PEPIN
WI ST HWY 35 BRDG 3 MI E OFPEPIN,WI
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 00		0.325	1.050	0.110	0.034	0.120
72/11/04	09 26		0.520	0.920	0.126	0.046	0.147
73/02/27	10 40		0.750	0.460	0.086	0.058	0.090
73/03/04	10 20		0.430	0.580	0.038	0.032	0.085
73/03/20			0.390	1.050	0.294	0.050	0.115
73/04/18	09 49		1.620	0.660	0.030	0.033	0.115
73/05/02	14 00		0.300	1.700	0.198	0.048	0.230
73/05/22	12 35		0.220	1.900	0.060	0.033	1.900
73/06/05	08 30		0.189	1.200	0.018	0.036	0.115
73/07/25	13 02		0.042	1.320	0.029	0.054	0.180
73/08/20	14 10		0.210	2.500	0.082	0.056	0.115
73/09/04	13 25		0.270	1.150	0.034	0.062	0.170

STORET RETRIEVAL DATE 74/10/30

27A4C1 LS27A4C1
44 34 30.0 092 19 30.0
RUSH RIVER (WI)
27 15 MAIDN ROCK WI
T/LAKE PEPIN
WI ST HWY 35 BRDG 1 MI NW MAIDEN ROCK WI
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 30		0.327	0.225	0.024	0.017	0.048
72/11/04	09 40		0.295	1.680	0.130	0.110	0.280
73/01/17	15 50		1.920		0.025	0.020	0.090
73/02/27	11 15		1.880	0.100K	0.019	0.016	0.020
73/03/04	10 43		1.920	0.460	0.068	0.017	0.035
73/03/20			2.100	0.750	0.110	0.042	0.060
73/04/18	10 25		1.800	0.360	0.054		0.080
73/05/02	14 25		1.320	2.600	0.115	0.115	0.340
73/05/22	13 15		1.640	0.270	0.080	0.020	0.060
73/06/05	08 57		1.500	0.580	0.031	0.011	0.030
73/07/25	13 27		1.560	0.340	0.026	0.025	0.055
73/08/20	13 36		1.600	1.320	0.031	0.023	0.035
73/09/04	13 55		1.460	1.540	0.026	0.132	0.390

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A4D1 LS27A4D1
44 35 00.0 092 26 30.0
ISABELLE CREEK
27 15 MAIDEN ROCK
T/LAKE PEPIN
WI ST HWY 35 ABDG E BAY CITY, WI
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	10 50		0.460	0.600	0.075	0.240	0.360
72/11/04	10 20		0.325	1.650	0.250	0.410	0.670
73/01/17	16 00		2.000	1.320	0.490	0.950	1.160
73/02/27	11 34		2.040	0.270	0.013	0.200	0.270
73/03/04	10 53		1.680	0.850	0.022	0.420	0.480
73/03/20			1.940	0.710	0.070	0.231	0.290
73/04/18	10 35		4.000	0.300	0.170	0.087	0.345
73/05/02	14 40		1.540	3.550	0.320	0.560	
73/06/05	09 04		1.080	0.740	0.029	0.810	0.910
73/07/25	13 45		2.500	0.880	0.160	0.470	0.640
73/08/20	13 20		2.020	0.350	0.027	0.520	0.580
73/09/04	14 15		2.180	1.000	0.019	0.410	0.470

STORET RETRIEVAL DATE 74/10/30

27A4F1 LS27A4F1
44 31 00.0 092 54 00.0
CANNON RIVER
27 15 HASTINGS
T/LAKE PEPIN
BRDG DNSTRM US52 BRDG N CANNON FALLS
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	11 45		0.810	1.550	0.154	0.200	0.260
72/11/04	14 00		0.680	3.300	0.240	0.210	0.320
73/01/17	10 45		2.060	0.250	0.052	0.030	0.037
73/02/27	13 30		3.000	1.380	0.320	0.250	0.300
73/03/04	13 04		3.500	2.200	0.189	0.100	0.180
73/03/20			4.300	2.900	0.790	0.168	0.240
73/04/18	12 30		3.700	2.300	0.357	0.094	0.300
73/05/02	10 05		3.000	2.600	0.240	0.095	0.310
73/05/22	09 30		3.400	1.470	0.190	0.093	0.165
73/06/05	12 28		3.100	3.570	0.340	0.100	0.155
73/07/25	15 40			1.100	0.063	0.102	0.180
73/08/20	11 18		1.700	2.700	0.088	0.147	0.195
73/09/05	11 25		2.400	2.800	0.115	0.220	0.250

STORET RETRIEVAL DATE 74/10/30

27A4F2 LS27A4F2
44 34 00.0 092 44 00.0
CANNON RIVER
27 15 RED WING
T/LAKE PEPIN
CO HWY 7 BRDG S OF WELCH BEL CAN FLS STP
11EPALES 21111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	12 35		0.760	1.400	0.072	0.189	0.240
72/11/04	14 20		0.350	1.540	0.170	0.230	0.300
73/01/18	10 35		2.800	3.570	0.590	0.430	0.680
73/02/27	14 15		3.000	0.690	0.170	0.198	0.240
73/03/04	13 35		3.500	1.680	0.850	0.100	0.190
73/03/20			4.400	1.800	0.450	0.176	0.260
73/04/18	13 10		3.900	2.700	0.400	0.096	0.250
73/05/07	11 00		2.900	2.800	0.120	0.085	0.345
73/05/22	09 55		3.400	2.300	0.100	0.090	0.170
73/06/05	11 55		3.300	2.400	0.056	0.092	0.170
73/07/25	15 12		2.160	1.470	0.075	0.110	0.310
73/08/20	10 50		1.920	1.050	0.034	0.140	0.220
73/09/05	10 40		2.600	1.200	0.036	0.200	0.245

STORET RETRIEVAL DATE 74/10/30

27A4H1 LS27A4H1
44 30 30.0 092 19 30.0
WELLS CREEK
27 15 MAIDEN ROCK
T/LAKE PEPIN
CO HWY 2 BRDG E FRONTENAC
IIEPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	08 45		0.310	0.250	0.054	0.046	0.099
72/11/04	08 30		0.240	0.875	0.102	0.077	0.190
73/01/17	12 55		1.600	0.870	0.076	0.039	0.200
73/02/27	09 00		1.540	1.600	0.100	0.044	0.290
73/03/04	09 30		1.400	1.150	0.360	0.033	0.080
73/03/20			1.720	1.260	0.198	0.071	0.142
73/04/18	08 55		1.560	0.800	0.052	0.093	0.195
73/05/02	12 50		1.260	3.500	0.189	0.138	0.665
73/05/22	16 25		1.240	2.000	0.052	0.040	0.120
73/06/05	07 40		1.220	1.890	0.063	0.040	0.108
73/07/25	12 01		1.460	1.950	0.030	0.154	0.560
73/08/20	15 20		1.220	0.310	0.017	0.069	0.130
73/09/04	12 25		1.180	1.210	0.031	0.086	0.220

STORET RETRIEVAL DATE 74/10/30

27A4J1 LS27A4J1
44 28 00.0 092 17 30.0
GILBERT CREEK
27 15 LAKE CITY
T/LAKE PEPIN
US 61 BRDG 1 MI NW OF LAKE CITY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	08 55		0.225	1.000	0.032	0.052	0.315
72/11/04	08 46		0.230	0.830	0.087	0.126	0.260
73/01/17	14 15		1.180	0.720	0.061	0.039	0.165
73/02/27	09 15		1.100	0.140	0.015	0.029	0.065
73/03/04	09 40		1.100	0.340	0.010	0.027	0.070
73/03/20			1.480	0.310	0.066	0.048	0.085
73/04/17	09 08		1.400	1.470	0.044	0.052	0.123
73/05/02	13 10		1.640	2.600	0.110	0.180	0.700
73/05/22	16 00		1.040	2.400	0.031	0.070	0.290
73/06/05	09 50		0.880	1.690	0.150	0.035	0.075
73/07/25	12 09		0.810	0.310	0.012	0.050	0.110
73/08/20	15 05		0.820	0.100K	0.018	0.046	0.075
73/09/04	12 35		0.970	1.980	0.058	0.189	0.575

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A4K1 LS27A4K1
44 26 00.0 092 15 30.0
MILLER CREEK
27 15 LAKE CITY
T/LAKE PEPIN
BANK UNDER US 61 BRDG SE OFLAKE CITY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
72/10/14	09 10		0.300	0.300	0.040	0.035	0.098
72/11/04	09 00		0.325	0.730	0.105	0.099	0.180
73/01/17	14 25		1.760	0.340	0.023	0.033	0.070
73/02/27	09 35		1.660	0.100K	0.005K	0.015	0.030
73/03/04	09 47		1.760	0.390	0.005K	0.016	0.030
73/03/20			1.900	2.660	0.885	0.210	0.290
73/04/18	09 15		1.620	0.800	0.019	0.030	0.105
73/05/02	13 20		1.680	2.100	0.096	0.147	0.460
73/05/22	16 10		1.600	0.260	0.026	0.019	0.030
73/06/05	08 00		1.720	1.890	0.320	0.033	0.095
73/07/25	12 19		1.520	1.260	0.019	0.050	0.347
73/08/20	14 50		1.500	0.100K	0.016	0.031	0.065
73/09/04	12 47		1.660	1.150	0.029	0.115	0.290

K: VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 74/10/30

27A451 AS27A451 P012195
44 45 00.0 092 50 30.0
HASTINGS
27 15 HASTINGS
T/LAKE PEPIN
MISSISSIPPI RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/02/06 00 00 CP(T)- 73/02/26 24 00			1.000	27.600	16.000	9.300	9.600	1.260	1.250
73/03/06 00 00 CP(T)- 73/03/06 24 00			0.840	18.000	8.300	7.600	7.900	1.000	1.240
73/04/04 00 00 CP(T)- 73/04/05 24 00			0.120	39.900	23.500	8.500	11.500	1.300	1.510
73/05/04 00 00 CP(T)- 73/05/04 24 00			0.300	26.000	9.300	5.050	6.400	1.510	1.280
73/06/03 00 00 CP(T)- 73/06/03 24 00			0.370	25.000	12.810	6.720	8.400	1.350	1.310
73/07/03			0.230	26.000	7.600	8.900	9.150	1.680	1.540
73/08/08			0.260	31.000	16.300	6.900	7.800	1.500	1.490
73/09/06			0.110	26.000	8.800	7.740	8.750	1.560	1.430
73/10/01 00 00			0.160	19.000	10.400	6.800	8.000	1.290	1.340
73/11/01			0.150	21.000	9.000	6.500	7.100	1.340	1.340
73/12/04 00 00 CP(T)- 73/12/04 24 00			0.060	26.000	14.000	7.750	9.417	1.390	1.420
74/01/09 00 00 CP(T)- 74/01/09 24 00			0.360	17.300	9.300	5.400	7.000	1.460	1.330

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